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Device for testing the electromagnetic compatibility of systems having large dimensions

Especially in the military field it is **known** that EMC-susceptibility tests are based on a pulse-shaped short stimulation. With these test by far stronger inhomogeneous fields come to application. Through the usual shape of the wave guides from the source to the termination of the impulse, no optimal testing field for civil requirements can be produced. Bends in the wave guide, geometrical changes of the wave guide from the source to the termination relative to its return conductor, a mismatched adaptation between the measurement of the equipment under test and the testing volume, the arrangement of the loading device in the testing volume and the testing volume loss originating by this, rail shaped and other sparking gaps between impulse source and field-generating wave guide arranged in an angle to the wave guide which differ largely in the geometry from the wave guide, lead to reflections which influence the extension of the pulse negatively and, by this, lead to a deterioration of the produced electromagnetic field in the testing volume. Furthermore, too long wave guides lead to an obliteration of the pulse, respectively a radiation of energy, as usual in many installations, and, with that, restrict its frequency spectra. With sine shaped fed wave guides or strip lines dimension-conditioned frequency range restrictions occur. Also with other similar testing methods, as the use of antennas with a determined directive diagram in an appropriate dimensioned unachoic chamber as usual in the automobile technique, no economical justifiable testing against electromagnetic radiated fields is possible for larger systems. In particular, no special susceptibility test for a whole train is existing at present.

Burst generators, which produce nano second impulses (5/50 ns) in fast succession and over controllable spark gaps with variable amplitudes, belong also to the state of art in the technique (DE 43 40 514 C2). However, conditioned by construction, these burst generators cannot replace a testing device described in the above mentioned patent claim for systems having large dimensions but serve rather the conductor led component test.

The advantages obtained by the invention consist in particular of the enormous time saving in testing time, the obtained field quality and the applicability for any long equipment under test with simultaneous minimal length of a single pulse conducting wave guide achieved through the modular structure. The test of a whole train in the far field, without a movement of the radiation

source while keeping the field homogeneity, can be conducted with a wave guide width differing only little from the train width.

The invention mentioned in the patent claim underlies the **problem**, to create generally for a complete system having large dimensions, a homogeneous testing field accepted by rules of the civil EMC-susceptibility-technique (ENV 50140).

This problem will be **solved** by the characteristics mentioned in patent claim 1 that several of these IGW, ICW, return conductors and terminating characteristic impedance's in the described arrangement combine units parallel, modular, to a common triggering mechanism and, by this, creating a testing chamber applicable for a system with large dimensions.

The **advantages** obtained by the invention consist especially in, instead of the piecewise EMC-susceptibility-test of systems with large dimensions leading to wrong results, a complete illumination of the equipment under test can be made (all) at once in nano seconds or in a few seconds while running repeatingly. Through keeping the characteristic impedance, a testing field with extraordinary quality will be produced.

The **testing chamber** with large dimensions results from the parallel mounting of the module shown in figure 1 with further modules equal in construction. A change of the field polarization can be reached by turning the arrangement around the length axle of equipment under test.

Impulse production

At first, the IGW is unloaded. Over a triggered spark gap the IGW or all parallel switched IGWs will be charged simultaneously through a high voltage source to a voltage U_o (preferably DC-voltage). The spark gap extinguishes due to the resulting potential equality and the regress of current intensity resulting from this. The impulse will be released independently after approx. 100 ms by closing the rail gap by means of many little arcing channels which connect the IGW with the ICW as a load. With the help of the rail shaped spark gap arises an equal electromagnetic impact of the ICW with the impulse. The maximal width of the rail shaped spark gap and, by this, the width of a module results from manufacturing possibilities.

With the usual excitation of a wave guide at a point, this leads, through the different conductor length, to a time delay of the current on the single wave guides. This delay in time of the wave on the different rods leads, as the inductivity of the spark gap and the change of the characteristic impedance to a obliteration of the flanks of the rectangular shaped impulse and, by this, to a loss in frequency range width of the produced frequency spectrum.

In the case of the rail shaped spark gap the load will be adapted to the impedance of the loading device. Thereby, the initial value of the voltage amounts exactly $U_o/2$. Through the voltage step from U_o to $U_o/2$, a travelling wave will be produced which runs in the directions of the IGW-beginning. After a transmission time τ of the used wave guide the travelling wave reaches the IGW-beginning, will be reflected almost completely at the high resistant spark gap ($r_u = 1$) and a resulting voltage zero arises. After the double running time $2\ \tau$ the wave reaches the IGW-end again. With an arcing spark gap, it is completed reflection free ($r_u = 0$). A voltage impulse arises on the ICW. This impulse will jump at the time of switching from zero to $U_o/2$ and after $2\ \tau$ again to zero.

Field quality

The whole testing chamber fulfils the sense of the requirements of the ENV 50140 and is suitable for testing the **susceptibility** test relative to the field homogeneity. A comparison extending the requirements of the ENV 50140 onto the three levels in the testing chamber shows

the in fig. 5 illustrated variation between point 14 as reference point and respectively all other measuring points (6 to 12 possible points exceed the 6-dB-criterion).